DESCRIPTION OF THE STUDY AREA

"There is great power in being in place, in knowing the watershed we belong to, in knowing the processes that have shaped the geography"

-- Terry Tempest Williams

NATURAL RESOURCES

Artist George Catlin, traveling by steamboat up the Missouri River in 1832, went ashore to climb a steep prairie-covered bluff and discovered a landscape where, as he wrote, "…thousand velvet-covered hills go tossing and leaping down with steep or graceful declivities" (Mutel 1989a). He was describing the Loess Hills: a narrow north-south band of rugged hills stretching along the eastern edge of the pancake-flat Missouri River floodplain in present-day Iowa. These "mountains in miniature" (as they were later called) could not fail to draw the attention of early explorers.

Photo courtesy of Don Poggonsee

Topography

The Loess Hills are a distinctive topographic region encompassing over 640,000 acres and extending for nearly 200 miles in a narrow band adjacent to the Missouri River valley. They constitute one of seven principal landform regions in Iowa (Figure 2). Although loess is a widespread geologic deposit, its development in western Iowa is of such magnitude, accumulating to depths of 150 feet in some places, that it dominates the landscape. The terrain is characterized by distinctive shapes: steep, narrow ridge crests, peaks, and saddles; numerous steep side slopes and branching spurs; and precipitous bluffs, some with sheer, nearly vertical faces rising from the adjoining Missouri River floodplain. These deposits form an extensive landscape of unique hill forms that are unparalleled in the United States and rare around the world. The Loess Hills' intricately sculptured loess deposits

have been described as "the best example of loess topography not only in the Central Lowlands, but in the United States." (NPS 1985). This striking landform is an outstanding example of a landscape formed by two fundamental geological processes -- wind and erosion.

Geology

Loess is a common geologic material and is thinly spread over much of the country's agricultural midsection. More significant accumulations of this windblown silt are known especially from eastern Washington State, southeastern Nebraska, the central and southern Mississippi Valley, as well as the Midwest. It is, however, the large contiguous tracts of unusually thick loess sculpted into a distinctive topography with a significant geologic record that sets the Loess Hills of western Iowa apart from the others.

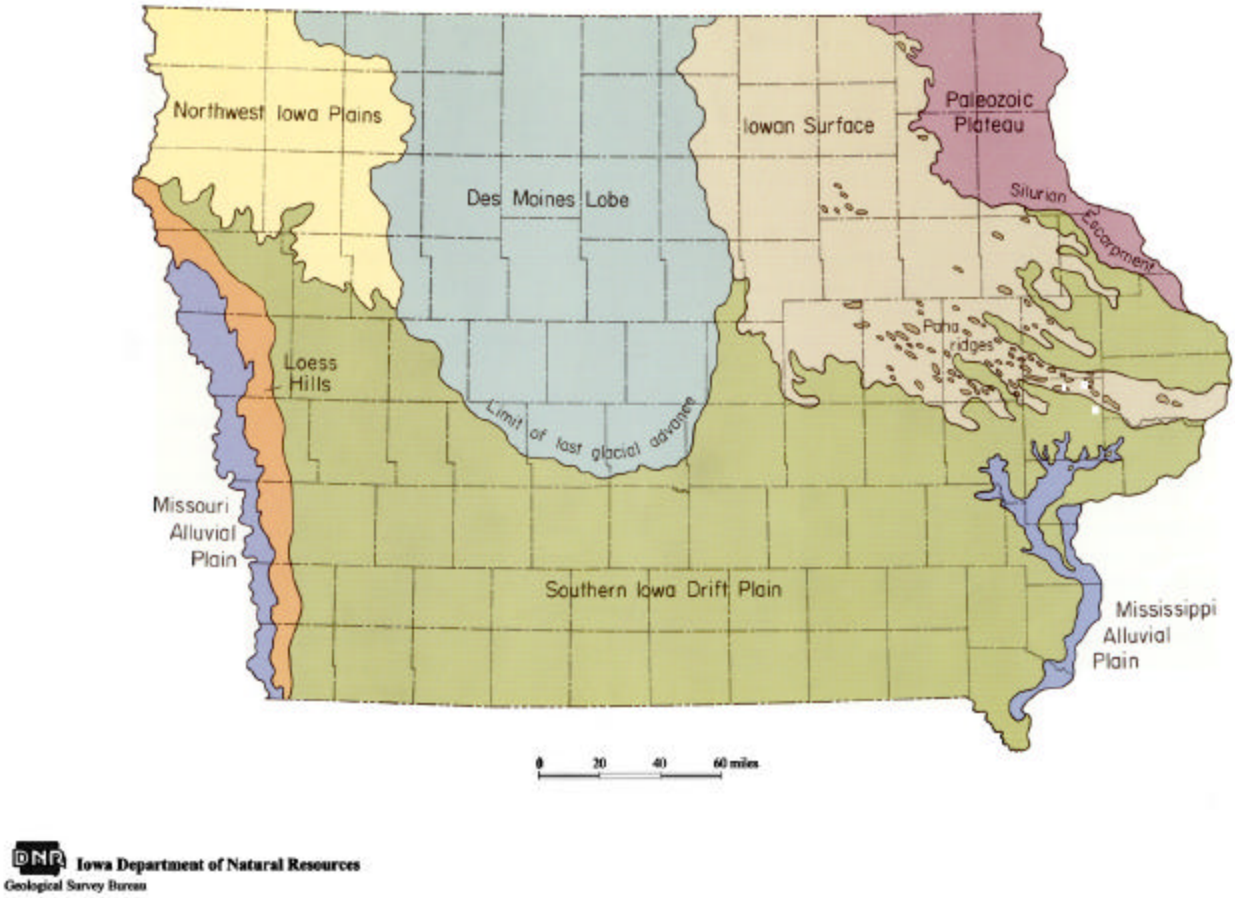
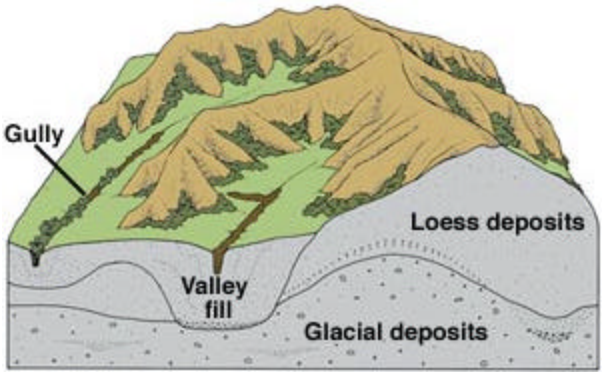


Figure 2: Seven Principal Landform Regions of Iowa (Prior 1991)

The Loess Hills are composed of three major geologic units. From oldest to youngest, the layers are known as the Loveland Loess (140,000 to 160,000 years old), the Pisgah Loess (28,000 to 35,000 years old), and the Peoria Loess (12,500 to 25,000 years old). Most of the landform region consists of large continuous tracts of deep silt deposited by the wind 30,000 to 12,000 years ago, and sculpted into distinctive terrain during the last 12,000 years (Bettis 1990).

During parts of the Wisconsinan glacial period (especially 30,000 to 12,000 years ago), the Missouri River valley was covered with a maze of braided streams carrying the outwash of glaciers that were melting to the north, their waters milky with glacier-ground silt. The Missouri River was one of the largest of these meltwater routes. Streams surged during the warmer months of the year and dissipated when winter's cold ended glacial melting. At those times, drying expanses of abundant silt were lifted by strong winds and carried eastward until topographic obstructions and shifting air currents caused the particles to drop. Over time, massive accumulations of loess were deposited. The deepest deposits formed directly adjacent to the north-south stretch of the Missouri Valley source, forming the nascent Loess Hills.



Adapted from: Landforms of Iowa, J.C. Prior, 1991. Patricia J. Lohmann, artist. Iowa Dept. of Natural Resources.

While glaciers and wind provided the raw material for the hills, it was the action of water, over the last 12,000 years, that sculpted the thick loess deposits into the distinctive topographic features that are visible today. Such rugged, high-relief landscapes are otherwise uncommon in the Central Lowlands, the nation's broad mid-section where Pleistocene glaciers have leveled the land. The divergent, angular ridges form a steep, corrugated landscape with a maze of sharp ridgelines, sheer bluffs, and sidespurs that extend across the horizon. The more gently sloped valley bottoms are often entrenched with deeply incised gullies. Side spurs lead off of major ridgelines, only to diverge again to form their own sidespurs – all of which give testimony to the dense drainage network carved into this landscape. The Loess Hills constitute an eolian landform region that expresses the work of glaciers, the action of wind, and the erosive sculpture of water in shaping the landscape.

These massive accumulations of unconsolidated lightweight material, unlike sand dunes, normally remain remarkably firm and stable. Cohesion of the silt particles enables steep, dramatic bluffs to stand erect and intact as long as the loess remains dry and undisturbed. Natural processes tend to keep it this way: the well-drained loess dries rapidly after rain because water infiltrates easily, and precipitation moves quickly off the steep slopes. However, if saturated or disturbed, the gritty particles can succumb easily to forces of water and gravity. This combination of particle cohesion and high erosion potential explains the shapes that dominate this landform region. Slabs – sometimes entire bluffs – of saturated

loess collapse and slump downslope; eroded loess spreads out into valley bottoms or is carried away in sediment-laden streams; dramatic gullies advance headward and deepen; and bit by bit the Loess Hills continue to change in form.

In contrast to the distinct, precipitous western edge of the Loess Hills along the Missouri Valley, the eastern boundary of the landform region is more difficult to define. The Loess Hills merge gradually with the adjoining Southern Iowa Drift Plain or Northwest Iowa Plains. The classic elements of Loess Hills' topography are not as obvious, nor as plentiful in these marginal, eastern areas of the landform region. This is because of the gradual thinning of the wind-deposited wedge of loess in an eastward direction, away from the Missouri River source area. It becomes more difficult to differentiate the true Loess Hills terrain from the steeply rolling topography of the Southern Iowa Drift Plain, which is also loess mantled but without sufficient thickness to alter the appearance of the landscape. The eastern boundary is a somewhat arbitrary line based on the presence or absence of distinguishing topographic features, summit heights, the degree of drainage density, the presence of defining drainage divides, soil types, and loess thickness. Because of the variability in the original loess depth, the thickness of the underlying glacial drift, and the elevation of the underlying bedrock, features of the Hills also vary from north to south. The sharp, intricate terrain typical of the central and southern Hills is more subdued in far-northern Plymouth County, where bedrock is closer to the surface. In contrast, angular, dissected features are especially well developed in Harrison and Monona Counties, where the loess deposits are broadest and deepest.

Geologic Investigations

The Loess Hills claim a long history of geologic interest and investigations. Clues within the loess have helped geologists reconstruct significant geologic events and develop climatic models. Scattered deposits of whitish volcanic ash, exposed near the Harrison-Monona county line, have been traced to eruptions from now-extinct volcanoes located near Yellowstone National Park in Wyoming. These windblown deposits, dated between 620,000 and 710,000 years ago, have been valuable in separating and dating mid-continental glacial deposits. Geologists also visit the scientifically significant exposure of Loveland Loess at its geological type-section in the central Loess Hills, where Interstate 80 cuts through the bluffline in northwestern Pottawattamie County. Here, 130 feet of vertical exposures reveal the internal composition of the loess deposits. Glacial till is covered with 19 feet of Loveland Loess deposited between 140,000 and 160,000 years ago (Illinoian age). This is covered by over 100 feet of younger Wisconsin age loess. This particular exposure is the standard used by geologists to define the characteristics of the Loveland Loess formation, the most widespread pre-Wisconsinan loess in the mid-continent. Loess kindchen (loess dolls), often exposed in Loess Hills roadcuts, have caught the interest of geologists and the public alike. These knobby pebbles and stones ranging up to the size of grapefruit are concretions of calcium carbonate formed in the loess by percolating groundwater. The nodules are of increasing geologic interest because of their potential to preserve a geochemical record of paleoclimatic change in continental environments.

Elsewhere along roadcuts and in quarries, far older Cretaceous-age sedimentary bedrock of limestone, sandstone, and shale (in the northern Loess Hills) and Pennsylvanian limestones (farther south) are exposed beneath the loess and glacial drift. These rock units, as well as

sand and gravel deposits and the loess deposits, have long been quarried for aggregate, as a construction resource, and for fill-dirt. It is worth noting that these deeper earth materials and their relative resistance to erosion account for the scalloped character of the Loess Hills bluffline and changes in the overall width of the Missouri Valley. Soil loss and the susceptibility of loess to gully erosion in the Loess Hills have prompted research into erosional processes and soil preservation strategies. Additionally, because loess was deposited by Ice-Age winds, it represents a record of past climates. The U.S. Geological Survey is collecting information valuable to testing computer models of past climates.

Paleontology

Significant fossil assemblages, some of the richest in Iowa, have been found in the Loess Hills. Fossils of Pleistocene snails and small mammals have helped to decipher the sequence of shifting forest and grassland communities that alternately covered the region in ancient times. More spectacular are the outstanding fossil remains of mammoths, mastodons, ground sloths, caribou, camel, and giant beaver, along with other animals that roamed this region during the Pleistocene. Numerous fossils of this diverse Ice-Age fauna have been unearthed from sand and gravel layers within glacial drift deposits that underlie the loess. The so-called "Aftonian fossil fauna," discovered in the Loess Hills and described by naturalist Bohumil Shimek and geologist Samuel Calvin in the early 1900s, provided the first detailed reports of Iowa's fascinating glacial-age animals (Calvin 1909; Shimek 1909b).

Abundant snail fossils found within the loess provided a crucial key to deciphering the origins of loess and Iowa's Loess Hills. Eighteenth-century geologists initially conjectured that loess had been laid down in water. In the early 1900s, however, naturalist Bohumil Shimek and others correctly deduced that loess was a wind deposit. Shimek's identification of numerous fossil land snails buried in the loess supported his theory.

Natural Communities

Photo courtesy of Loess Hills Alliance

For over a century, Iowa's Loess Hills have attracted botanists who have studied the unusual assemblage of plants found in this area. Approximately 700 species of vascular plants – over a third of Iowa's flora – have been identified in the Loess Hills. The high diversity of both species and ecological communities is explained by the varied microsites created by the dissected terrain. The regional climate, on the whole, is mid-continental with extreme temperature variations exemplified by cold winters and hot summers. However, in this landscape with its diverse exposures, one can climb within a few hundred feet from moist valley woodlands onto sun-scorched, droughty

ridgetop sparsely vegetated with drought-tolerant grasses and forbs.

Until the 1850s, fire-dependent native prairies dominated the Loess Hills, as was true of most of the western Central Lowlands. Eastern deciduous forest species flourished only in moist sites along creeks and at the base of sheltered slopes. A dynamic border separated the two major types of ecosystems, with frequent wildfires favoring the sweeping expanses of prairie grasslands. The post-settlement exclusion of wildfire has allowed woodlands to expand into many areas previously covered by prairie. However, prairies still cover broad expanses of the driest, harshest Loess Hills sites: the westernmost bluffs and sun-and wind-exposed ridgetops with their adjacent south- and west-facing slopes. Protected from intensive agricultural use by rugged topography, many of these prairies have retained much of their original integrity and diversity and remain relatively large. Indeed, Loess Hills prairies in Iowa in 1980 comprised a minimum of 22,250 acres (three-percent of the landform region), over half of the remaining prairies in the state that was once the heart of the tall-grass prairie (Selby 2000; Appendix D).

The expanses of native prairies and forests that today dominate the Loess Hills constitute a highly diverse mixture of eastern and western plant and animal species, many of which reach the edge of their distributional range. At this significant biological crossroads, eastern deciduous forest species at or near the edge of their range interlace with dry prairies that are fostered by the harsh extremely dry environment (produced by wind, sun, and well drained soils) and include a rich mixture of plants and animals typically found much farther to the west. A total of 96 Loess Hills species are of interest because they are either western species at or near the eastern edge of their range, eastern species at or near the western edge of their range, or are listed by the State of Iowa as endangered, threatened, or special concern species. The 39 state-listed species constitute one of the largest concentrations of rare species in the state. While 11 of the listed species have woodland affinities, 25 are prairie species, a dominance that reflects the relatively large amount of prairie habitat remaining in the Loess Hills (Appendix A). The continued woodland invasion of remaining prairies poses a major threat to many of these regionally rare species. While seven federally listed species occur in one or more of the seven counties that the landform is located in, there are no known occurrences within the upland areas of the Loess Hills (Howell, personal communication).

Most scientific interest has been focused on the prairies that house a variety of rare western plants and animals at the eastern terminus of their distributional range. These dry prairies are dominated by the grasses little bluestem and side-oats grama, joined on the westernmost bluffs by plains muhly. Great Plains forbs such as skeletonweed, soapweed, and scarlet gaura lend a distinctive element to mid-grass communities. These plant communities like all prairies-evolved in the presence of wildfire, which stimulates the vigor and health of these fire-adapted ecosystems. The plant communities are matched by western animals such as the Great Plains skink, prairie rattlesnake, and plains pocket mouse, which join more ubiquitous species such as the badger to form a grassland fauna of small, secretive animals. Western species are most diverse toward the north, where Loess Hills prairies are the largest. These mid-grass prairies, with their western forbs, are unique in Iowa. They probably resemble the mixed grass prairies 70 miles and more to the west more than either other dry prairies in the

region, or the tallgrass prairies that are the norm for this longitude (for a listing of species scientific names, see Appendix B).

Renewed awareness of the landform region's significance shifted attention toward the identification of areas worthy of preservation, and led to the identification of the Loess Hills in 1998 as one of The Nature Conservancy's national priorities. The Nature Conservancy's studies of the central tallgrass ecoregion have revealed that the Loess Hills contain the best examples in the world of three natural community types: Eastern Great Plains Big Bluestem Loess Prairie, Loess Hills Little Bluestem Dry Prairie, and Eastern Great Plains Bur Oak Woodland. Additional recent scientific studies include vegetation analyses primarily by Rosburg and lepidopteral investigations. These have progressed simultaneously with intensified management efforts.

Woody vegetation (primarily forests) covers about 73,500 acres (11 percent) of the landform region (IDNR 1992). The majority of the forests result from woody invasion of prairies, a process that has been aggravated by the exclusion of wildfires that kill most trees and stimulate native grasslands. Bur oak is the most abundant tree species. Subdominants such as ironwood or red elm may commingle with the bur oak but the understory of bur oak woodlands is often sparse, consisting of a few common species such as Virginia creeper. The low species-richness and diversity emphasize the immaturity of these forests. This is also true of very dense eastern red cedar woodlands that plague pastures. Invasive woodlands of green ash and red elm mix with cottonwood, ironwood, or other trees to cover very disturbed hillsides. Although uncommon, older forests occupying historically wooded locations remain western outposts of the eastern deciduous forest. Examples of such more diverse woodlands can be seen in the three Loess Hills state parks and elsewhere, usually as pockets in deep ravines.

Woodland animals include common species such as the fox squirrel, eastern cottontail, and woodchuck, as well as a diverse assemblage of birds. Larger animals such as the red fox, white-tailed deer, and coyote wander between woodlands and grasslands. A few rare species such as the hickory hairstreak butterfly and speckled kingsnake also inhabit Loess Hills forests. Forest animals in general are increasing and expanding their ranges northward as woodlands expand, often at the cost of prairie animals. For example, all increasing Loess Hills reptiles are woodland species, while prairie reptiles are declining in number (Christiansen and Mabry 1985).

Wetlands and Floodplains

The floodplains of rivers and streams through the Loess Hills were purposely included in the Study Area to provide a holistic, continuous depiction of the landform region. As such, two classes of streams are found in the Loess Hills. The first class includes the numerous small, intermittent streams originating in local Loess Hills watersheds. These have not been channelized. There are also larger streams in big valleys such as the Little Sioux, Floyd, Maple, and Boyer, which originate east of the Loess Hills, and cross through the region before joining the Missouri River. Most of these tributaries have been channelized in their lower reaches or are silt-laden and unproductive. Broad, alluvial plains are associated with

the larger streams, including some oxbow lakes and backwater sloughs. Small impoundments are also scattered on lower slopes throughout the region. The natural alluvial wetlands in particular often are within the view of scenic vistas from the Loess Hills.

SCENIC RESOURCES

"The question is not what you look at, but what you see"

-Henry David Thoreau, 1854

The Loess Hills have numerous scenic qualities and hence, have considerable visual appeal. Natural landscapes, a rich cultural legacy, and agricultural traditions contribute to the scenic quality, and the character of the Loess Hills. The sharply defined western edge of the region is the strongest and most scenic characteristic; the stark contrast along the bluff and the river floodplain creates the most recognizable visible "signature" of the landform. Andreas (1875) described the views as thus:

> Bordering [the Missouri River bottoms] on the east, the range of bluffs rises steep and grand, in many places almost perpendicular from two to three hundred feet in height. The range is parted by numerous narrow valleys and ravines, which descend from the adjacent uplands, but never loses its distinctive outlines. This remarkable range, rising abruptly from the sweeping plain, without a rock or stone on its face presents a view at once varied, grand and beautiful. The adjacent uplands are broken and in many places [are] too uneven for tillage; but are well adapted to grazing, and are frequently interspersed with thrifty groves of timber. Further east the broken outlines give place to a beautiful, undulating or waved surface, peculiar to the Western Slope, alternating with level valleys from a half mile to a mile in width bordering the streams. Everywhere there is a pleasing variety of scenery enhanced in loveliness by a pure atmosphere and a constant succession of rich, mellow tints which never fail to charm the eye with new and delightful forms and colors revealed by the perpetual play of light and shadow upon the varied outlines.

Photo courtesy of Don Poggensee

Within the interior Loess Hills, scenic views unfold along the many byways that traverse the Loess Hills. Farms appear nestled into coves surrounded by the wooded hills, terraces of crops or pastures step up the side of rolling hills, and the Missouri River bottoms are occasionally glimpsed through folds in the hills. Historic churches and pioneer cemeteries dot the landscape. From high points on the bluffs, spectacular views open up over the broad and fertile expanse of the Missouri River bottom. Interviews conducted for *The Loess Hills Scenic Byway Corridor Management Plan* (GHRC&D 1998), hereafter the Byway Plan, found that "[t]he scenic qualities of the Loess Hills are widely recognized as one of the Scenic Byway Corridor's most distinguishing features. … viewing the fall colors of native prairie and hardwood forests in the Loess Hills is among the most popular attractions for travelers." The *Plan* also notes that farming and the associated historic structures that reflect the agrarian lifestyles are "important components of scenic quality in the Loess Hills." Visual perception studies conducted for the Byway Plan identified a number of preferred features. These include native prairie vegetation, water (as a stream, lake, or wetland), a combination of land cover (forest, prairie, and grassland), juxtaposition of the extreme edge (steepest topography) to the inner landform (moderately rolling topography), proximity to public recreation areas, and landscape views. The Byway Plan identified over 15 scenic overlooks dispersed throughout the 7-county study area that contribute to the overall scenic resources of the National Byway. Viewshed maps are contained in the Byway Plan (a viewshed, as defined by the Byway Plan, is a quantitative measure of distance seen from a given point on the Byway) and can assist with the development of land-use strategies to preserve the scenic quality of the Loess Hills.

A SENSE OF PLACE: THE HUMAN STORY

"When I am here, the spirits of our ancestors are all around me"

-Pete Fee, Ioway Tribe
Iowa-Portrait of the Land (2000)

The human story of the Loess Hills of western Iowa is integrally related to the tale of the landform region's prehistoric and historic occupants over the last 12,000 to 13,000 years. American Indians have lived in, hunted in, farmed in, and traveled throughout the landform region for thousands of years. In the historic period, the Loess Hills were home to tribes that were indigenous to the region, such as the Ioway (Iowa) and Otos; they were also home to the displaced Potawatomis. French fur traders and missionaries discovered the Loess Hills in the early 1700s. Several historically important routes crossed through and paralleled the Loess Hills, including the paths taken by Lewis and Clark in 1804 and the Mormons from 1846-1869. A "track" of the Underground Railroad led slaves from Kansas to freedom by way of the Loess Hills of Fremont County. Determined farmers employed whatever technology was available to raise crops on the steep hillsides. This human story is woven into the fabric of the Loess Hills.

A brief sketch highlighting human use and occupation of the Loess Hills follows. For a detailed report on the prehistory and history of the study area, see Appendix C.

American Indian Occupation

Present knowledge of Loess Hills archeology hints at special relationships between humans and Loess Hills resources at different times in the past. The steep and narrow valleys in the Loess Hills may have offered shelter from the elements, at least on a seasonal basis, and thus been a preferred place of seasonal residence. Small valleys within the Hills may have offered both timber and arable land needed for small farming communities to prosper in Late Prehistoric times. One locality, near Glenwood, appears to have especially attracted farming people, whose lodges and fields dotted the prehistoric landscape there for perhaps 250 years or more. The sweeping vistas of the Missouri River valley afforded by the high bluffs and ridges of the Loess Hills may have been a factor in choosing suitable eternal resting places for the dead. The reasons for these apparent relationships may be better understood in the future as our knowledge of the archeological record of the Loess Hills increases. The Loess Hills may be viewed as a storehouse of knowledge that is "banked" for the future.

Paleoindian Period: As glaciers receded in the upper Midwest, winds accumulated fine quartz silt into thick loess deposits in western Iowa. Humans arrived soon after most of the sediment was deposited, about 11,000 B.C. to 8,500 B.C. These Paleoindians were small bands of foragers who led a nomadic existence, roaming the hills and plains in search of large game herds, such as bison, mammoths, and mastodons (Benchley et al. 1997; Alex 2000). These people are characterized in the archeological record by the highly distinctive, finely crafted, chipped stone projectile points that they fashioned to serve as spear tips and hand cutting tools. In the Loess Hills, Paleoindian projectile points have been found as isolated artifacts in several locations, but no habitation or game kill/processing sites are known. Although evidence of the Paleoindian period in the Loess Hills is scant, future discoveries of Paleoindian artifacts, associated with the remains of large game animals hunted during Paleoindian times, is a strong possibility.

Archaic Period: The next archeological period represented in the Loess Hills is the Archaic (8,500 B.C. to approximately 800 B.C.). Archaic sites, recognized by notched and stemmed projectile points, have been documented in the study area. Although still highly mobile, Archaic peoples made greater use of semi-permanent base camps as well as smaller seasonal camps. Throughout the approximately 8,000-year span of the Archaic period, small mobile groups, probably based on nuclear or extended families, engaged in hunting and gathering as primary economic pursuits. However, through time, as the resources exploited became more diversified, groups became less mobile. Greater use was made of seasonal resource exploitation base camps and band composition became larger and more cohesive. People came together repeatedly to bury their dead in given localities and with more variety of burial artifact accompaniments. These changes were gradual and are difficult to perceive in the archeological record because Archaic-age archeological sites are few and generally little investigated, particularly in the Loess Hills. The eventual transition to what archeologists call the Woodland period is marked not so much by changes in lifestyle as by the introduction or elaboration of new ways of obtaining food and burying the dead.

Woodland Period: The Archaic period was succeeded by the Woodland (approximately 800 B.C. to A.D. 1200) and is characterized by the introduction of ceramic vessels, burial of the dead in mounds, and increased reliance on wild and cultivated plant foods. Regional differences in artifact assemblages, particularly the decoration of pottery, became more distinct through the Woodland period. Woodland period people were more sedentary than their predecessors were, as exemplified by the small hamlets of substantial wattle-and-daub or earth-covered structures that they lived in. Like the Archaic period, the Woodland period is divided into Early, Middle, and Late subperiods. The regional Woodland variation found in western Iowa, including the Loess Hills, is often termed Plains Woodland or sometimes the Mid-America Woodland tradition (Benchley et al. 1997; Benn 1986). Woodland sites are generally more abundant than Archaic sites.

The Late Prehistoric Period: By the advent of the Late Prehistoric period (A.D. 900-1000 through approximately A.D. 1650), changes transformed Late Woodland cultures into several strikingly different regional archeological complexes that were centered on a settled village life and based largely on the raising of garden crops. Widespread cultivation of corn on an intensive scale led to the development of several distinctive regional cultures whose people lived in permanent settlements and whose economy was based on a blend of corn cultivation and hunting. These included three distinctive village complexes that flourished in the Loess Hills. All three (Great Oasis, Mill Creek, and Nebraska Phase) were approximately coexistent, and their presence in the Loess Hills lasted about 300 years. With the possible exception of Great Oasis, who may not have raised much corn, but may have obtained it from Mill Creek neighbors, these complexes shared a basic economy that consisted of horticulture and seasonal hunting of bison and other mammals, supplemented by the gathering of wild plant foods, mussels, and fish. The Nebraska Phase people, like their Mill Creek and Great Oasis neighbors in the northern Loess Hills, disappeared from the archeological record in Iowa by about A.D. 1300 (Alex 2000).

Early Euro-American Contact and Settlement

Whatever unknown circumstances caused the elimination of Late Prehistoric peoples from the Loess Hills in the 14th century, the effect was lasting. For more than three centuries, the Loess Hills were virtually devoid of human activity. Evidence indicates that by the mid-17th century, occasional use of the Loess Hills by native people, now in contact with the early French fur traders, had recurred.

The French trader LeSeuer heralded the beginning of the historic period in 1701 by creating the first documentary record of human activity in Western Iowa, a description of an Ioway village northeast of the Loess Hills near Spirit Lake (Mutel 1994). Rivers provided initial access for the traders and priests, and later for more substantial numbers of settlers. Further inland, fur traders followed the Indian trails. In the northern Loess Hills, these paths tended to follow the ridge tops; farther south, they nestled in the valleys.

Westward Expansion: French fur traders and missionaries were the first Euro-Americans to discover the Loess Hills, claiming the region for their mother country. Following their loss of the Seven Years War in 1763, the French transferred their claim to Spain. However, the Spanish returned the area to France in 1800 and in 1803, France sold the area to the United

States as part of the Louisiana Purchase. The following year, President Thomas Jefferson sent Meriwether Lewis and William Clark to explore the new territory. The expedition spent much of July and August 1804 traveling the portion of the Missouri River adjacent to the Loess Hills, exploring, hunting, and documenting their beauty and bounty.

In 1833 the U.S. government relocated the Potowatomis, approximately 2,000 in number, from Illinois to southwestern Iowa. The largest village was near modern day Council Bluffs, with smaller villages farther south. The Potowatomis lived primarily by hunting the game-laden Loess Hills, gathering native plants and planting small gardens.

White settlers trickled into the Loess Hills area in the late 1830s and early 1840s. The early towns were established along transportation routes, near the Missouri River, at the base of the bluffs, or in the valleys of the Missouri's tributaries.

The first steamboats began running the Missouri River to serve the fur traders in 1831. Gradually the market changed and agricultural supplies and residential goods became the primary cargoes. In the 1850s and 1860s, most of those coming to Council Bluffs traveled by land to St. Louis or Jefferson City, Missouri, then by steamboat up the Missouri River (Holt 1925). For more than a quarter-century, Council Bluffs was the northernmost regular stop. Regular steamboat service to Sioux City was established in 1859 (Holt 1925); and by 1860 Sioux City's market dominated the Missouri River traffic.

Early roads went north-south along the base of the bluffs, and east-west along river valleys when feasible. By the 1850s stagecoach service was available along Iowa's western border, and post offices were established in most towns along the routes (Rogers 1990). Additional stagecoach roads traversed the hills; the trace from Glenwood to Tabor is still easily visible along the ridge tops (Blackburn, personal communication). Nevertheless, development of the Loess Hills region was sparse until railroads came in the 1860s and 1870s, permitting settlement further away from the waterways.

The Railroads: Railroad companies promoted the area, and as soon as they published their routes, men came to assist in constructing the railroads, and stayed to work on the railroads or farms. Hotels were established to accommodate the laborers, and continued to thrive on the business of rail travelers. Women made money as laundresses and bakers, and rented rooms to boarders. Towns grew around the railroads following a rhythmic pattern: first depots and grain storage facilities, then businesses, and finally homes (Bonney 1994; Conard and Cunning 1990). This pattern is still evident in most railroad towns located in the Loess Hills.

Agriculture: Nineteenth-century farmstead development reflected a functional response to the terrain and its suitability for agriculture. Settlers built their homes and farmsteads close to a source of water, which could be either a creek or a spring exiting at the base of the bluff. Prior to about 1940, farmsteads were often located on the elevated terraces located at the base of the bluff edge, usually on the north side of the alluvial fan of small tributaries. The main house and primary farm structures were generally oriented to the southwest or south with bluffs buffering the north winds. Cellars were built into the base of the bluffs. Farmers

Photo courtesy of Loess Hills Alliance

adjusted their land use in accordance with what was available at any particular time, cultivating the prairie tops when the valley was too marshy; moving to the valley once the marshes were drained and all the while using the hillsides for grazing (Sayre 1989).

The farms of Iowa produced wheat, corn, oats, grains, potatoes, sorghum, flax, grasses/hay, root plants, "salad" plants, and other fruits and vegetables. In addition, Iowa was fifth nationally in livestock production. In specific categories of livestock production, Iowa ranked fourth in production of hogs; fifth in horses; and sixth in cattle and oxen (Iowa Board of Immigration 1870).

Western Iowa's farmers were among the first to feel the effects of the Depression. Prices for farm goods plummeted, and the agricultural depression preceded the disastrous stock market crash by several years. During the Great Depression, much land changed hands as banks or insurance companies foreclosed on loans, and neighbors bought and sold parcels (Blackburn personal communication). Hoping to stop the foreclosures, the governors of the Midwestern farm states met in Sioux City in September 1932 to plan a program including a moratorium on farm debts, increased credit at lower interest, and surplus controls. About 5,000 farmers were also in attendance (Schweider 1996).

Depression-era farmers benefited greatly from New Deal programs, better farming methods, and new technology. Technological developments with durable effects included the electrification of rural areas, the genesis of hybrid seed corn, and the increased availability of farm machinery (Schweider 1996). The introduction of steam- and later, gasoline-powered machinery encouraged the use of more land for market crops (Sayre 1989). Aerial photographs from 1938 to the 1970s show that the size of farm fields and of farms themselves increased steadily. Rising farm product prices in the 1970s encouraged farmers to increase the size of their land holdings and buy more machinery, thus increasing their debt. The risk was realized in the 1980s when product prices plummeted. By 1984, the value of farmland decreased by twenty percent from the previous year. Many farmers, particularly those under the age of 35, were threatened with the potential loss of their land, precipitating what became known as the "Farm Crisis." Agriculture-related industries also suffered. By 1987, Iowa had 22,000 fewer farms than it had in 1973 (Schweider 1996).

Conservation and Reclamation: Among the most visible and lasting New Deal achievements in the study area was the creation and/or improvement of public recreational facilities. Among those accomplishments was the establishment of Stone State Park in Woodbury County and major modifications to Waubonsie State Park in Fremont County. Monona County hosted the Jones Creek watershed project. The Jones Creek watershed

Photo courtesy of Loess Hills Alliance

project was one of ten experimental land reclamation projects in the country that were responsible for changing the direction of the nation's land reclamation program. The success of the Jones Creek watershed project encouraged the Soil Conservation Service (today's Natural Resource Conservation Service) to continue the construction of “little dams” nationwide instead of the extremely expensive "large dams" on major waterways that were common before the test projects. Small dams, dikes, and other erosion control features are now common in the Loess Hills landform region.

Changes to the Landscape: Human alterations to the Loess Hills landscape were at first small in scale; horse hooves formed trails “where passage was easiest—through lowlands or along the western edge of the bluffs” (Mutel 1989b). Then more dramatic changes occurred: settlers built dams for water power; carved the bluffs to construct caves for storage, kilns, and stables; quarried limestone, sand, gravel, shale and construction fill; leveled bluffs to make way for cities; constructed roads and railroads; and farmed the prairies. Settlers reshaped the valleys as well, straightening the meandering Missouri River and its tributaries into channels to hasten drainage and constructing dams to control flow and dikes to prevent flooding. Some impacts were inadvertent: plowing slopes for cropland accelerated erosion; grazing large herds of cattle degraded the prairies, also exacerbating erosion; and baring soil for construction or recreational purposes. Exposing the soil to water destabilized the loess, often rendering it unable to support its own weight. Farmers cut native woodlands for construction and fuel, and replaced them with exotic species. They simultaneously suppressed wildfires, which allowed woody species to commence massive invasion of the prairie grassland. River channelization and drainage projects destroyed formerly abundant marshlands. Settlers altered native habitats and hunted many large mammals to local extinction. The Loess Hills had been transformed.

CULTURAL RESOURCES

> ***"The soul of a people is the image it cherishes of itself, the aspect in which it sees itself against its past, the attributes to which its future conduct must respond"***
>
> *-Archibald MacLeish, 1949*

Significant Prehistoric Resources: The western Iowa fluvial system has been extremely dynamic during the last 10,000 years (Holocene), caused by the combination of easily eroded materials, high drainage density, and great local relief. Major episodes of stream

entrenchment and sediment transport are recorded in numerous valley fills. This geomorphic history has important implications for the preservation of prehistoric cultural remains. These geological processes have served both to preserve archeological deposits and to destroy them. Where archeological sites have not been eroded, archeological remains of certain ages can be expected to occur within alluvial fills that were deposited during those times. Thus, knowledge of Holocene geomorphology not only provides clues to where sites of certain ages may be found, but also provides an indication of the general age of archeological deposits. Although a rich record of the prehistoric human past has been recorded within the Loess Hills, continuing erosion of the Loess Hills means that the potential for this prehistoric record to be expanded in the future is great.

There are 827 archeological sites that have been recorded within the Loess Hills, though an extremely small percentage of the region has been subjected to intensive, systematic archeological surveys. Undoubtedly there are thousands more that have yet to be discovered and recorded. Consequently, the archeological resources within the Loess Hills, singly in most instances and surely collectively, have the potential to illuminate much about prehistoric cultures that were present in the Loess Hills.

Two archeological properties in the Loess Hills are listed on the National Register of Historic Places--the multi-component Benson site and Pony Creek Park (Jones 1998). The Benson site is a large, multi-component Woodland site located in Woodbury County. It was observed in 1982 in the form of deeply buried hearths, pottery, and other cultural debris visible in gully walls for a distance of 2,200 feet. Components of Late Archaic, Early Woodland, Middle Woodland, and Late Woodland age are believed to be present (Thompson 1984). Although excavations have not taken place here, the Benson site offers tremendous potential to yield information that will be important to understanding major changes in cultural adaptations to late Holocene environments (Thompson 1984). The Benson site was listed on the National Register of Historic Places in 1984. Located in Mills County, Pony Creek Park is owned and operated as a recreational park by the Mills County Conservation Board. It was listed on the National Register in 1971 and contains two Nebraska Phase earthlodge sites. Forty-six other presently recorded archeological sites in the Loess Hills consist of two or more Native American archeological components or occupations (Jones, personal communication). Most of these offer the potential for comparative study, and many more will be discovered as archeological research continues in the Loess Hills.

Currently, there is no comprehensive list of archeological properties found to be eligible for the National Register of Historic Places, although several sites have been determined eligible, or are considered eligible by the State Historical Society of Iowa (Jones, personal communication).

Significant Historic Resources: There are four National Historic Landmark (NHL) properties in the Loess Hills. The following includes descriptive information from the National Historic Landmark documentation.

> ***Floyd Monument:*** Located in Sioux City, the 100-foot-tall sandstone obelisk overlooking the Missouri River valley commemorates the burial site of

Sergeant Charles Floyd. Floyd was the Lewis and Clark expedition's only fatality, and the first United States soldier to die west of the Mississippi River. Lewis and Clark buried Floyd's remains high above the Missouri both to protect the burial from flood damage and to provide a landmark by which subsequent travelers could fix their location. The Floyd Monument was the first property to be designated as a National Historic Landmark under the authority of the Historic Sites Act. The monument is publicly owned and accessible.

National Park Service photo

The Sergeant Floyd: One of few surviving U.S. Army Corps of Engineers vessels, the survey and towboat is dry-berthed on the banks of the Missouri River at mile marker 730, adjacent to the Floyd Monument (Sioux City). The steel-hulled, twin-screwed vessel has a steel and wood superstructure. It measures 138.4 feet in length with a 30-foot beam, a 5.6-foot depth of hold, a draft (fully loaded) of 3.9 feet, a height of approximately 37 feet, and a 306-ton displacement. The *Sergeant Floyd* was part of the federal government's comprehensive plan for flood control and improved navigation on the Mississippi and Missouri Rivers. It is publicly owned and accessible.

Woodbury County Courthouse: Architect William L. Steele's Woodbury County Courthouse has been called one of the finest examples of Prairie Style architecture in the United States. Occupying nearly a city block in Sioux City, the basic structure is a nearly square four-story building with an eight-story tower rising from the center core. The exterior is comprised of granite, brick, and terra cotta punctuated with steel-framed windows. The structure, which continues to serve its original function, was designated for its architectural significance, and does not contribute to the significance of the Loess Hills landform region. The courthouse is publicly owned and accessible.

Dodge House: Situated on a loess bluff in historic Council Bluffs, this three-story, fourteen-room brick structure was designed by architect W.W. Boyington of Chicago. Four chimneys pierce the mansard roof. The interior is graced with black walnut woodwork, stucco medallions, and bronze and silver hinges. The residence was designated a National Historic Landmark for its association with Civil War General and railroad tycoon Greenville Dodge. It does not contribute to the significance of the landform. The Dodge House is publicly owned and accessible.

SOCIAL AND ECONOMIC ENVIRONMENT[1]

Population

The people of the Loess Hills are evocative of those found in communities and rural areas throughout much of Iowa and the Midwest. The seven counties have a combined estimated 2000 population of just over 264,000. All counties within the study area lost population between the 1980 and the 1990 censuses. That trend, however, has largely reversed during the 1990s. Fremont and Monona County continued to experience a decline in population during the past decade. Mills County, because of its proximity to the Omaha metropolitan area, has realized the greatest expansion in population, growing by more than 11 percent during the 1990s. The racial composition of the study area is largely Caucasian (over 96 percent of the population). Only Woodbury and Pottawattamie Counties have non-white populations greater than one percent. Between 1990 and 2000, most of the growth in western Iowa occurred in the Omaha-Council Bluffs or Sioux City areas (U.S. Census Bureau 2001). Table 1 summarizes the estimated 2000 population for the seven counties, together with recent trends in the population.

Table 1: Population Estimates and Trends, Seven-County Area

County	1980 Census	1990 Census	2000 Estimate	% Change 1980-1999	% Change 1990-2000
Plymouth	24,743	23,388	24,849	0.3	6.2
Woodbury	100,884	98,276	103,877	0.5	5.7
Monona	11,692	10,034	10,020	-13.7	-0.1
Harrison	16,348	14,730	15,666	-6.9	6.4
Pottawattamie	86,561	82,628	87,704	-0.2	6.1
Mills	13,406	13,202	14,547	9.7	10.2
Fremont	9,401	8,226	8,010	-18.0	-2.6
Total	263,035	250,484	264,673	-1.0	5.7

Source: U.S. Census Bureau 2001

The landscape of western Iowa is predominantly rural and agricultural. A number of small communities can be found throughout the hills, in addition to portions of the metropolitan communities of Sioux City and Council Bluffs. Many of these communities have seen population trends that parallel those of the county where they are located. The populations of most communities within Fremont County have declined over the past two decades. Conversely, many of the communities in the Woodbury County, which includes Sioux City, have experienced double-digit population gains over the same period. Table 2 summarizes the estimated 1998 population for the communities of the region, together with recent trends

[1] Social and economic data specific to the landform study area as depicted in figure 1 (640,000-acres) are not available. Therefore, unless otherwise noted, data presented in this section are representative of the entire county or for the entire seven-county region (3,236,108 acres).

in the population. The communities listed are those that are within the Loess Hills landform region or are along the Loess Hills National Scenic Byway.

Economy and Tourism

As is true for western Iowa and other areas in the Great Plains, agriculture has been highly important to the Loess Hills counties. However, the nature and extent of farming is in transition. Farming is experiencing trends similar to those observed in many other agricultural regions. For example, the number of farms in the study area has steadily declined over the past three decades while, concurrently, the average size of a farm has increased. As noted previously, the farm crisis of 1984 affected the state; by 1987, Iowa had 22,000 fewer farms than it had in 1973 (Schweider 1996). Table 3 illustrates these trends.

In terms of earnings, farming is the leading economic sector for one county in the study area, Harrison County (Table 4); farming accounts for 22.7, 22.5, and 21.2 percent of the source of earnings for Monona, Harrison, and Fremont counties, respectively. Overall, the counties of the study area have a comparatively diverse economy. Manufacturing is the leading economic sector in Fremont and Plymouth Counties. The service sector is the primary sector in Monona, Pottawattamie, and Woodbury Counties. The government sector accounts for more than one-third of total earnings in Mills County.

Another noteworthy component of the Loess Hills economy is quarrying. According to data from the Iowa Department of Natural Resources (IDNR 1997), there are 27 state-licensed mining operations active in the Loess Hills; an additional 25 licensed facilities within the region are listed as "closed." Almost all of these facilities extract sand and gravel; a few quarry limestone or agricultural lime. Most operations are small businesses, employing fewer than 20 people. About one dozen such businesses operate within the counties of the study area.

Loess also is extracted from the Hills for use as construction fill and for other purposes. The "borrow pits" from which the loess is extracted scar the landscape and often are left in highly erodable conditions. Iowa statute and regulation does not consider loess a mineral, hence, the Iowa Division of Soil Conservation does not license or register sites working with just loess. As a result, the full extent and impact of loess extraction is difficult to quantify. Most units of local government do not have ordinances that are designed to protect the loess. Plymouth County, however, is working to modify its zoning ordinances to reflect protections for the Hills that were set forth in a recently adopted new comprehensive plan.

Tourism is important to the economy of western Iowa. The Loess Hills, related resources, and other nearby attractions are magnets that attract recreationists and other visitors to the region. Visitors to the area require amenities such as service stations, restaurants, and lodging. Table 4 shows that the retail and service sectors account for between 16.6 and 41.4 percent of total earnings in the seven counties of the study area.

Table 2: Population Estimates and Trends, Counties and Major Towns

Community	1980 Census	1990 Census	1998 Estimate	% Change 1980-1998	% Change 1990-1998
Plymouth Co.					
Akron	1,517	1,450	1,445	-4.7	-0.3
Westfield	199	160	158	-20.6	-1.3
Woodbury Co.					
Bronson	289	209	233	-19.4	11.5
Lawton	477	482	637	42.5	32.2
Oto	172	118	140	-18.6	18.6
Sergeant Bluff	2,416	2,772	3,095	28.1	11.7
Sioux City	82,003	80,505	82,697	0.8	2.7
Smithland	282	252	271	-3.9	7.5
Monona Co.					
Castana	228	159	162	-28.9	1.9
Moorhead	264	259	235	-11.0	-9.3
Rodney	82	71	74	-9.8	4.2
Turin	103	95	96	-6.8	1.1
Harrison Co.					
Logan	1,540	1,401	1.443	-6.3	3.0
Magnolia	207	204	224	8.2	9.8
Missouri Valley	3,107	2,888	2,822	-9.2	-2.3
Pisgah	307	268	292	-4.9	9.0
Pottawattamie Co.					
Council Bluffs	56,449	54,315	56,312	-0.2	3.7
Crescent	547	469	458	-16.3	-2.3
Mills Co.					
Glenwood	5,280	4,960	5,244	-0.7	5.7
Fremont Co.					
Hamburg	1,597	1,248	1,159	-27.4	-7.1
Riverton	342	333	307	-10.2	-7.8
Sidney	1,308	1,253	1,178	-9.9	-6.0
Tabor	1,088	994	986	-9.4	-0.8
Thurman	221	239	226	2.3	-5.4

Source: U.S. Census Bureau 1998

Table 3: Number and Size of Farms, 1969-1992

County	No. of Farms 1969	No. of Farms 1997	% Change 1969-1997	Average Farm Size (acres) 1969	Average Farm Size (acres) 1997	% Change 1969-1997
Plymouth	2173	1490	-31.4%	247	344	39.3%
Woodbury	1970	1306	-33.7%	262	381	45.4%
Monona	1267	697	-45.0%	322	527	63.7%
Harrison	1490	876	-41.2%	282	448	58.9%
Pottawattamie	2277	1325	-41.8%	246	405	64.6%
Mills	868	496	-42.9%	310	468	51.0%
Fremont	976	568	-41.8%	328	560	70.7%
Total	**1574**	**965**	**-38.7%**	**285**	**448**	**56.9%**

Source: Iowa State University Extension 1999

Table 4: Sources of Earnings: Employed Persons 16 Years of Age or Older in 1994

	Counties						
Economic Sector	Plymouth	Woodbury	Monona	Harrison	Pottawattamie	Mills	Fremont
Farm	15.5%	**2.0%**	22.7%	**22.5%**	4.6%	17.7%	21.2%
Manufacturing	**23.2%**	15.6%	4.9%	4.9%	15.3%	1.4%	**31.1%**
Retail	9.1%	10.7%	10.3%	13.4%	13.1%	11.8%	5.2%
Finance*	4.1%	4.6%	3.5%	3.2%	3.7%	2.8%	2.5%
Services	15.2%	30.7%	**28.0%**	**17.1%**	**24.5%**	17.2%	**11.1%**
Government	10.8%	11.7%	14.7%	17.7%	15.9%	**36.7%**	10.1%
Other**	22.1%	24.6%	15.9%	21.3%	22.8%	12.4%	18.9%
* finance, insurance, & real estate							
** ag, services, mining, construction, transportation, public activities, wholesale trade							

Source: Iowa State University 1997

A 1996 study by two faculty members from Iowa State University evaluated the economic impact of recreation in the Loess Hills (Alexander and Otto 1997). That study identified a range of visitation, expenditures, and related variables that can be attributed to tourism within the region. The most conservative estimates identified in the study suggest that annual recreation-related visitation to the area was about 556,900 persons. Roughly visitors to the area spent $11.8 million per year. The average party size was about 2.4 persons, and the average daily expenditures of each party is about $51. The study estimated that these

expenditures support about 231 jobs, of which about two-thirds are in the retail sector and about 30 percent in the service sector. Expenditure information cited is in 1996 dollars. The Alexander and Otto study also found that 72 percent of respondents to their survey were local residents (defined as living within 100 miles of the point of survey). Local residents were likely to take multiple recreation trips to the Loess Hills each year (the average number of trips ranging between 7.8 and 11.6). About two-thirds of recreation visits to the region occurred on weekends, and most parties visited several sites in the area. The study found that DeSoto National Wildlife Refuge is by far the most popular single site that recreationists visit in the region; the southern Loess Hills (south of Council Bluffs) are much less frequently visited than the northern Hills.

Outdoor Recreation & Tourism Infrastructure: Tourism to the Loess Hills currently is promoted by entities such as the Iowa Division of Tourism, the Western Iowa Tourism Region, the Convention and Visitors Bureaus in Council Bluffs and Sioux City, the Welcome Centers in Harrison County (Missouri Valley) and Sioux City (the Sergeant Floyd Center), and the Loess Hills Hospitality Association.

Although some persons arrive in the area via flights to commercial airports in Sioux City, Iowa and Omaha, Nebraska, most visitors travel to the Loess Hills via automobile. A well-developed network of roads provides easy access to and within the region. Interstate Highway 29, a multi-state freeway connecting Canada and Kansas City, Missouri, generally runs parallel to the Loess Hills from Sioux City to the Iowa-Missouri line. Interstate Highways 80 and 680 intersect with the region in the vicinity of Council Bluffs, providing a simple "jumping-off point" for travelers from the east and the west who wish to explore the Hills. Many well-maintained state, county, and local roadways complement these highways.

The primary artery for automobile travel within the region is the Loess Hills National Scenic Byway. The Byway is a 220-mile road network that weaves throughout the landform region and nearby areas (Figure 1). The main stem of the Byway is a paved route that generally runs north to south. Sixteen loop routes that provide for short side trips enhance this primary route. The loop routes range between three and 19 miles in length, and are located along both paved and gravel roads. The main stem and the loop routes all are identified by distinctive highway signs that facilitate navigation through the Hills. A guidebook produced by the Federal Highway Administration and National Park Service (*Iowa's Loess Hills Scenic Byway*, date unknown) and other printed materials are available that interpret the resources of the region and direct travelers to area attractions.

Visitor services are well distributed through the Hills. Gasoline, diesel fuel, automobile service, lodging, and restaurants can be found in many communities. Hospitals or medical services are found in Sioux City, Moorhead, Missouri Valley, Tabor, Riverton, and Council Bluffs. Camping, both for tents and for recreational vehicles, is available in several locations.

Many of the attractions within the Loess Hills are related to the area's natural environment or to outdoor recreation. Both publicly and privately owned facilities provide opportunities for a wide range of outdoor recreation activities including hiking, picnicking, bicycling, horseback

riding, fishing, hunting, camping, and wildlife watching. The area also provides some opportunities for winter activities such as snow skiing, sledding, and snowmobiling.

According to *the Loess Hills Scenic Byway Corridor Management Plan* (GHRC&D 1998), there are more than 100 parks, recreation and wildlife areas, and outdoor recreation attractions in the Byway corridor. These attractions cover more than 57,000 acres of land both within and adjacent to the Study Area. Table 5 lists over 50 of the outdoor recreation areas along the Loess Hills National Scenic Byway and within the seven-county region. The areas shown in Table 5 range between two and 9,800 acres, with the majority being less than 100 acres in size.

The DeSoto National Wildlife Refuge, located along the Missouri River in Harrison County, is the only federally owned and managed facility near the study area. The Lewis and Clark National Historic Trail (NHT), a component of the National Trails System, parallels the Loess Hills from the Missouri state line to Sioux City.

Other attractions not directly associated with the Loess Hills also encourage visitors to the region. Good potential exists to integrate promotion of the Loess Hills as a destination into the marketing programs of these other regional sites. Examples of places in or near the landform region that draw people to the area include the Sioux City Art Center, Siouxland Historical Railroad Museum, Western Historic Trails Center, General Dodge House, Mount Crescent Ski Area and several casinos. Attractions near Omaha, Nebraska also bring people to the area. These include the Henry Doorly Zoo, Joslyn Art Museum, and the Western Heritage Museum.

As part of their investigation of the economic impacts of recreation in the Loess Hills, Alexander and Otto (1997) also explored the amenities that contribute to people's enjoyment of the region's resources. The study found that those amenities that contributed most positively to recreational experiences were closely associated with the natural environment (for example, scenic overlooks, trails, interpretive signs, picnic tables, grills, etc.). Amenities perceived to have neutral or negative contributions to enjoyment of the Hills included golf courses, RV parks, hotels and motels, restaurants, and service stations.

It is important to remember that nearly three out of four persons who participated in the study were local residents. Therefore, the perception that amenities such as hotels, restaurants, and service stations do not contribute to enjoyment of the area is logical, in that many respondents could fulfill their needs for lodging, food, and fuel by returning to their homes after a day in the Hills. Further, it is notable that the study surveyed only persons who were already visiting the area. Perceptions of desirable amenities might have been different if the survey had sampled *potential* visitors. It is possible that the lack of certain amenities actually dissuades some people from visiting the Loess Hills.

Table 5: Outdoor Recreational Resources in Seven County Region

NAME	ACRES
Plymouth County	
Big Sioux Park	33
Broken Kettle Grassland	1200
Deer Creek Lake	1020
Five Ridge Prairie State Preserve	790
Hillview Recreation Area	230
Knapp Prairie	277
Millsite Access	16
Silver Maple County Park	60
Woodbury County	
Bacon Creek Park	240
Curtain Timber	90
Fowler Forest Preserve	108
Inkpaduta River Access	2
Loess Ridge Nature Center	15
Oak Ridge Conservation Area	765
Riverside Bluffs	135
Sergeant Floyd Monument	120
Sgt. Floyd Welcome Center	5
Sioux City Prairie Preserve	151
Southwood Conservation Area	623
Stone State Park (also in Plymouth Co.)	1085
War Eagle Monument	23
Wimson Park	5.5
Monona County	
Gray's Landing	43
Loess Hills State Forest	3081
Loess Hills Wildlife Area	2800
Pawnee Recreation Area	10
Preparation Canyon State Park	345
Rodney Pits Recreation Area	60
Savery Pond	25
Schoenjahn Wildlife Preserve	125
Whiting Woods	80

NAME	ACRES
Harrison County	
DeSoto National Wildlife Refuge	9800
Fish Lake Wildlife Area	19
Gleason-Hubel Wildlife Area	165
Harrison County Historical Museum & Village	3
Lewis and Clark Memorial	40
Loess Hills State Forest	7800
Murray Hill Scenic Overlook	3
Sawmill Hollow Wildlife Area	155
Sioux Dam Fishing Access	10
Pottawattamie County	
Folsom Prairies (also in Mills Co.)	277
Hitchcock Nature Center	732
I-680 Scenic Overlook	Unknown
Smith Wildlife Area	2160
Wabash Trace Nature Trail	Unknown
Mills County	
Foothills Park	45
Mile Hill Lake Rec. Area	47
Pony Creek Park	50
Tree Lake	9
West Oak Forest	308
Fremont County	
Forney Lake	1128
Green Hollow Wildlife Area	341
O.S. Wing	140
Pinky's Glenn	58
Riverton Wildlife Area	2700
Sidney Recreation Area	150
Waubonsie State Park	1200

Source: Golden Hills RC&D 1998; IDNRb 2000

Land Ownership

Attesting to the rural character of the region, approximately 39,500 acres of the 640,000-acre study area are within the boundaries of incorporated areas. Hence, nearly 94 percent of the study area is unincorporated. Only 4.4 percent of the landform region is in public ownership or owned by The Nature Conservancy, a private conservation organization (Figure 3). The vast majority of the region is privately owned. Table 6 depicts private and public ownership within the landform study area, organized by county.

Overall land-cover patterns within the study area also reflect its rural character. Land cover is a generalized description of basic characteristics of the land as it appears on satellite imagery or aerial photography.

Land cover provides an approximation of land use within an area. Table 7 shows that 86 percent of the landform region is covered by grassland or row crops. These land covers are most prevalent in Woodbury County (91.3 percent) and least common in Fremont County (67.5 percent). Fremont County does have the highest percentage of wooded area (30.6).

Development of the landform region as evidenced by the "artificial" classification is most prevalent in the Council Bluffs/Omaha area (Pottawattamie and Mills County) and near Sioux City (Woodbury County).

The land use and land cover patterns described in Table 7 are derived from 1992 satellite imagery. Unfortunately, more recent data are not readily available that would allow for measurement of changes in these patterns. However, it is indisputable that changes are occurring within the Loess Hills landform region. These changes have the potential to drastically alter the character of the Loess Hills in some locations. Significant urban expansion is occurring in the Omaha, Council Bluffs, and Sioux City metropolitan areas. As a result, many areas in Mills, Pottawattamie, and Woodbury Counties are being converted from agriculture or natural land uses to residential and other types of built environments. The same trend is occurring, albeit to a lesser extent, in the other counties of the study area.

Photo courtesy of Don Poggensee

The scenic character that makes the Loess Hills so very attractive to recreationists is the same character that makes the landscape highly desirable as a place to build homes. Growth in residential development in the counties of the study area, as evidenced through the number of permits issued for new private housing units, has shown a generally upward trend over the past two decades. Further, the demand has accelerated during the 1990s. Between 1979 and 1990, the average annual number of private housing units authorized by building permits for the entire seven-county region that includes the study area was 412.

During the period of 1991-1997, the average annual number of permits was 925 (an increase of more than 124 percent). Of the entire seven county area, Woodbury and Mills Counties experienced the greatest percent change in the annual number of building permits issued from 1991-1997 as compared to the average issued between 1979 and 1990 (U.S. Census Bureau 1998). It is important to note that these statistics are for the counties as a whole, and not just for the study area. However, the desirability of the Loess Hills as a place to build homes would suggest that the study area itself experienced a similar, if not greater, level of growth in new housing starts.

This increase in residential development often has resulted in a corresponding decrease in the number of acres in agricultural land. Although most buyers of agricultural land in Iowa continue to be farmers who are increasing the size of their holdings, about 30 percent of purchases made in 1999 were by investors (Iowa State University 2000).

Table 6: Land Ownership of Loess Hills Study Area (640,000 acres)

	Percent Private	**Percent Public**	**Percent Other**
Plymouth County	89.3	7.3	3.4
Woodbury County	93.0	1.8	5.2
Monona County	94.2	5.6	0.2
Harrison County	90.6	6.5	3.0
Pottawattamie County	86.4	1.7	11.9
Mills County	92.2	4.1	3.7
Fremont County	93.1	5.8	1.1
Entire Landform Region	91.5	4.4	4.1

Source: As analyzed by Golden Hills Resource Conservation & Development, Inc., from IDNR data) (by percentage of total unincorporated land).

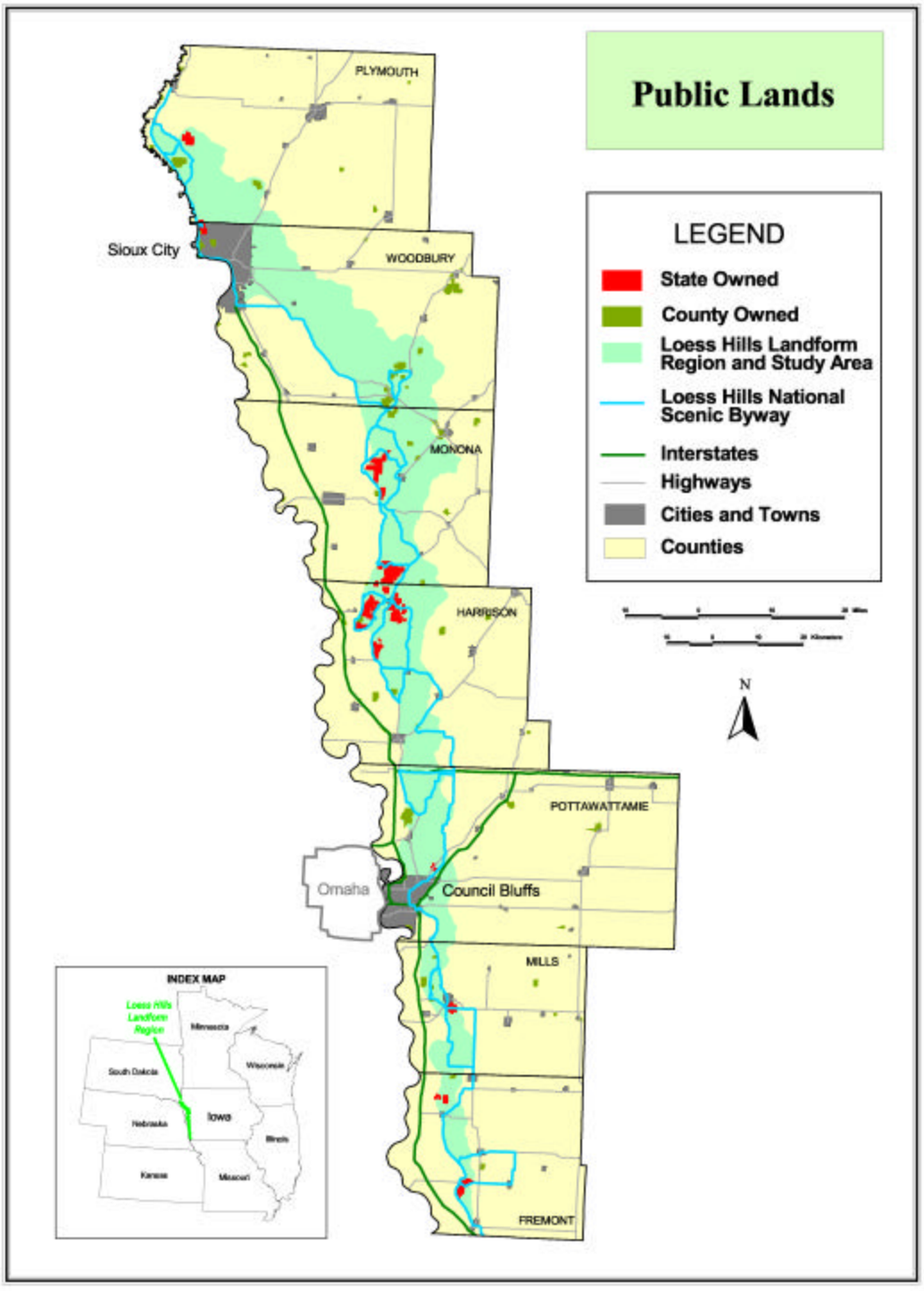


Figure 3: Public Lands

Table 7: Generalized Land Cover of Loess Hills Study Area (Expressed as a percent of total)

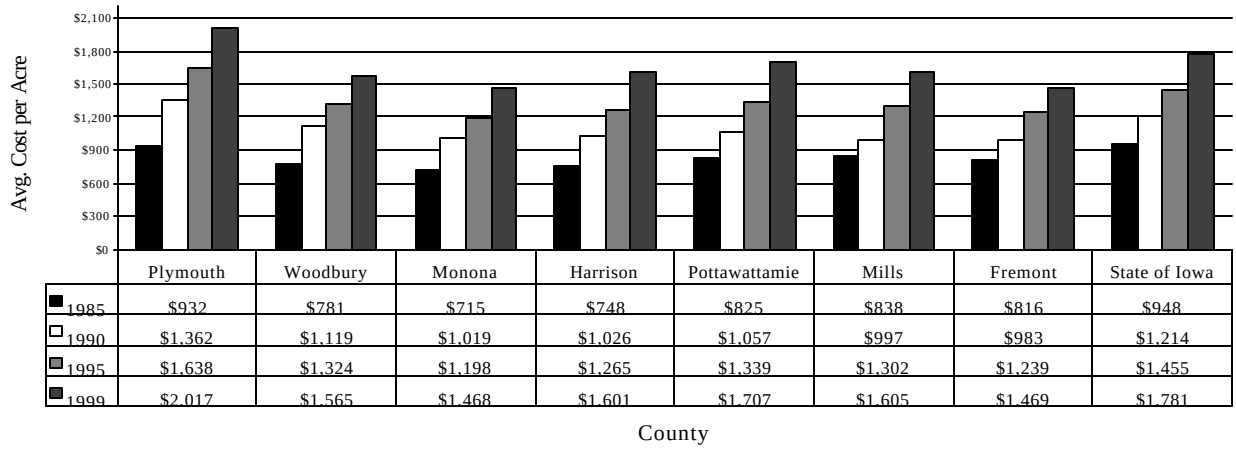
County	Percent Grassland	Percent Row Crops	Percent Woodland	Percent Artificial	Percent Barren/ Flood	Percent Water
Study Area (640,000 acres)	50.4	35.6	11.3	1.5	1.0	0.2
Plymouth *	65.3	28.0	6.0	0.2	0.3	0.1
Woodbury	51.1	40.3	4.4	2.3	1.7	0.2
Monona	52.5	32.2	13.8	0.1	1.1	0.3
Harrison	40.5	45.1	13.7	0.3	0.4	0.1
Pottawattamie	45.8	34.6	14.2	4.0	1.3	0.2
Mills	50.5	25.4	19.9	2.9	0.6	0.6
Fremont	48.7	18.8	30.6	1.3	0.4	0.2

Source: Golden Hills Resource Conservation & Development, Inc 2000.
*About 7,561 acres, mostly in Plymouth County, could not be classified due to persistent cloud cover on the satellite imagery.

Generalized Description of Land Cover Categories

Grassland – consists of non-woody surfaces such as prairies, wetlands, pastures, lawns, golf courses, hay fields.
Row Crops – consists mostly of agricultural crops (especially soybeans & corn).
Woodland – deciduous and coniferous forests, highly mixed grass & trees, windbreaks, & dense shrubs.
Artificial – pavement, concrete, roofing materials, metal structures. This classification includes roads, parking lots, buildings, etc.
Barren/Flood – natural surfaces covered with bare soil, gravel, & sand bars. Includes gravel pits, rock quarries, feedlots, & construction sites.
Water – includes lakes, reservoirs, large rivers & streams, sewage lagoons, and open water in wetlands.

Land values within the study area have steadily increased since the mid-1980s. Appreciation in land values within six of the seven counties within the study area has outpaced the growth of land values in Iowa as a whole. Five of the seven counties have experienced a more than two-fold increase in average land values since 1985. The largest percentage gain in land value was in Plymouth County (116.4 percent); the smallest percent gain was in Fremont County (80 percent). Respondents to a 1999 survey conducted by Iowa State University (Iowa State University 2000) identified five factors as having the most positive impacts on land values during 1999: government program payments, interest rates, crop yields, the supply of land available, and demand by investors. Figure 4 illustrates trends in the average value of farmland since 1985.



	Plymouth	Woodbury	Monona	Harrison	Pottawattamie	Mills	Fremont	State of Iowa
1985	$932	$781	$715	$748	$825	$838	$816	$948
1990	$1,362	$1,119	$1,019	$1,026	$1,057	$997	$983	$1,214
1995	$1,638	$1,324	$1,198	$1,265	$1,339	$1,302	$1,239	$1,455
1999	$2,017	$1,565	$1,468	$1,601	$1,707	$1,605	$1,469	$1,781

Source: Iowa State University 2000.

Figure 4: Trends in Farmland Values, 1985-1999
(Values are for the entire county, including areas outside the study area)

All counties within the landform region except Mills have countywide zoning ordinances in place. However, none of those ordinances have regulations specifically designed to address issues that are threatening the Loess Hills. These ordinances do not protect the region from insensitive residential, commercial, industrial, and agricultural developments. No tools are in place to help preserve the scenic attributes of the Hills. Excavation and quarrying within the Hills continues to erode the landscape and alter the natural configuration of the skyline and horizon.

Conservation Programs and Land-Use Planning

A number of state and federal conservation programs are contributing staff and funding for erosion control, wildlife habitat and water quality improvement, and prairie restoration programs in the Loess Hills. The Loess Hills Alliance (LHA), Fish and Wildlife Foundation, Golden Hills Resource Conservation and Development, Iowa Natural Heritage Foundation, Natural Resource Conservation Service, Soil and Water Conservation Districts, The Nature Conservancy, and other groups continue to provide information and services associated with a variety of conservation programs. In 2000, the LHA provided funding and matching grant opportunities that resulted in over $750,000 of land protection or economic growth projects (Loess Hills Alliance 2000). An ongoing effort, the Whole Farm planning initiative is utilized by six of the seven counties included in the Loess Hills landform region. Designed as a matching grants program with local Soil and Water Conservation Districts (SWCD) and in cooperation with the Iowa Division of Soil Conservation, local SWCD were able to promote and complete whole farm plans on 250 acres of private land. Whole farm plans are designed to encourage landowners to make maximum use of available state and federal soil, water, wildlife, and conservation programs (Loess Hills Alliance 2000). Most recently, $250,000

has been earmarked under the Farmland Protection Program (FPP) to preserve the Loess Hills from non-agricultural development.

The Nature Conservancy, Fish and Wildlife Foundation, the U.S. Fish and Wildlife Service, and the National Park Service have provided landowner assistance (funding, staff, and/or equipment) for prairie restoration, woody plant and exotic species control, and workshops on fire ecology and the use of prescribed fire. Other federal programs, such as the Conservation Reserve Program, Partners for Fish and Wildlife, Stewardship Incentives Program and the Wetlands Reserve Program are available to assist private landowners.

A number of comprehensive planning and zoning efforts are underway. In 2001, the LHA began soliciting requests for proposals to prepare a Comprehensive Plan for the seven-counties of the Loess Hills. This Plan will document existing studies, and other land-use data and serve as a template for counties in the Loess Hills to use (Sproul 2001). Plymouth County recently adopted an updated Comprehensive Plan that includes specific measures designed to control growth and protect the landforms; the county is proceeding to update its zoning regulations to reflect policies in the new plan. Two other counties, Mills and Woodbury, are developing Comprehensive Plans. The LHA is also developing a grant program to encourage county and city governments to undertake comprehensive planning and zoning which consider critical resource protection strategies for the Loess Hills landform. Finally, the *Loess Hills Scenic Byway Corridor Management Plan* (Golden Hills Rural Conservation Development 2000) is a useful tool available for land use planning. The *Byway Plan* identifies important resources and includes model ordinances designed to preserve the integrity of the resources in the Loess Hills.